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Relative Abundance, Habitat Preference, and Seasonal Occurrence of Two Species of Burying Beetles in Central Virginia (Silphidae)

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ABSTRACT

Two species of burying beetles in the genus *Nicrophorus* are widely distributed in Virginia but have not been studied ecologically. Many more *N. orbicollis* Say were captured in a 13-month drift fence/pitfall trap study in central Virginia than *N. tomentosus* Weber. They differed in their occurrences in hardwood, old field, and pine habitats with *N. orbicollis* preferring hardwoods and *N. tomentosus* having similar affinities for hardwoods and old fields. Except for five *N. tomentosus* in a loblolly pine forest, 48 or more individuals of both species occurred in all three habitats. Peak seasonal activity of *N. orbicollis* was July to August, whereas it was September for *N. tomentosus*. Previous studies inferred that *N. orbicollis* occurs more often in forests than other habitat types with little canopy and labeled *N. tomentosus* a habitat generalist. Our results support the prediction for *N. orbicollis* but *N. tomentosus* has a significant aversion to pine forests in central Virginia.

Key words: ecology, habitat, *Nicrophorus,* carrion beetles, seasonal activity, Virginia.

INTRODUCTION

Studies of vertebrates in contrasting terrestrial habitats reveal that most animals are distributed unequally between and among them. The differences are usually in the proportions of each species present in each habitat type rather than complete segregation (Kirkland, 1990; Mitchell et al., 1997). Invertebrate communities show the same pattern (e.g., Anderson et al., 1995; Burruss et al., 2011) but some, like phytophagous insects, are more habitat-specific than vertebrates. Changes in natural habitats caused by human activities have resulted in dramatic effects, such as complete elimination of canopy cover from logging. Although we cannot study the mosaic of forest and field habitats created by hurricanes, fire, and Native American activities before European invasion, we can infer the natural histories of native species by studying them in the contrasting habitats that currently exist. In the present study, we evaluate the habitat affinities and seasonal occurrences of one group of insects (burying

*Deceased

beetles, Silphidae) in three distinct habitat types (hardwood forests, old fields, planted pine forest). Previous studies suggested that *Nicrophorus orbicollis* (Rounded Burying Beetle) prefers forests over areas without canopy cover and *Nicrophorus tomentosus* (Tomentose Burying Beetle) is a habitat generalist (e.g., Shubeck, 1993; Lingafelter, 1995; Scott, 1998). Our hypothesis is that *N. orbicollis* will be found predominately in forests, whereas *N. tomentosus* will be distributed more evenly among the three habitat types.

MATERIALS AND METHODS

During the period from 7 September 1989 to 30 September 1990, JCM conducted an inventory for terrestrial vertebrates at several localities in the northern part of Cumberland Co., Virginia, in connection with a site evaluation for a proposed coal-fired generating plant. The study sites included two separate mixed, upland hardwood stands (designated as north [HW-N] and south [HW-S], both approximately 40+ yr in age), two areas that had been previously clearcut (old fields, also north [OF-N] and south [OF-S], 3 yr and 6 yr old, respectively), and a single stand of planted loblolly pine (*Pinus taeda*) (approximately 10 years old). Arrays were set at least 185 m away from the nearest edge of the adjacent habitat. The five sites were dispersed roughly along a line extending 3-6 km southwest of the town of Columbia (Fig. 1). Full site descriptions are in Pagels et al. (1992).

The primary sampling technique involved use of pitfall-drift fence arrays in the three habitat types. Each array included three 8-m long strips of aluminum flashing set upright in an exploded Y configuration with the proximal end of each arm placed about 7-8 m away from the center point in the study area. A plastic 5-gallon bucket was buried flush in the ground at each end of each arm; six pitfall traps in each array. Traps contained a preservative composed of 10% formalin and ethylene glycol, and were cleared at two-week intervals.

Burying beetles of the genus *Nicrophorus* often comprise a major component of pitfall captures, especially if any small mammals have been trapped and begun to decompose. In the Cumberland study, over 1,800 specimens of two species, *N. orbicollis* and *N. tomentosus*, fell into the pitfalls and form the basis for the present observations. Both of these species are statewide in Virginia, but *N. orbicollis* is more abundant eastward and is especially numerous in the Coastal Plain (R. L. Hoffman, pers. obs.). Conversely, *N. tomentosus* is by far more frequently taken in the mountains, as reflected by the numbers of captures recorded in the VMNH files.

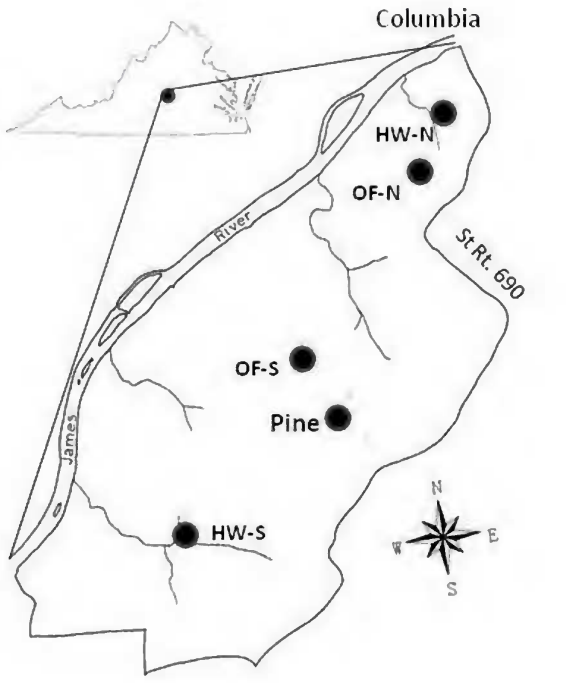

Fig. 1. Location of the five study sites in Cumberland County, Virginia. Abbreviations: HW-N = hardwoods north, HW-S = hardwoods south, OF-N = old field north, OF-S = old field south, Pine = planted pine forest.

RESULTS AND DISCUSSION

Nicrophorus orbicollis

We processed a total of 1,747 specimens of *N. orbicollis* (Table 1). Many of the beetles caught in hardwoods were the result of their attraction to decaying rodents in several buckets in August which skewed the numbers captured in this habitat type. Their preference for hardwoods is obvious (X^2 [Chi square] = 2,122.6, $P < 0.001$; April-September samples only to balance the comparison with effort in the pine site). Old fields are preferred over pine forests ($X^2 = 6.72$, $P < 0.05$; April-September samples only).

Other studies conducted in deciduous forests in eastern North America (e.g., Shubeck, 1993; Lomolino et al., 1995) have shown that, when having the option, *N. orbicollis* prefers forests over open biotopes, reflecting the remarkable preponderance found in Cumberland County hardwoods as noted above. When forests are lacking, as in the Great Plains, the species can function successfully in grassy, treeless areas (Lingafelter, 1995;

Table 1. Relative abundance and seasonal activity patterns of two species of burying beetles (*Nicrophorus*) in Cumberland County, Virginia, in three contrasting habitats. Abbreviations: HW – hardwoods, OF – old field, Pine – pine forest. Trap days: 2346 (HW), 2190 (OF), 1284 (pine). Numbers represent individual captures.

	N. orbicollis			*N. tomentosus*		
Month	HW	OF	Pine	HW	OF	Pine
Sept 89	38	0	-	14	10	-
Oct 89	9	0	-	5	1	-
Nov 89	0	0	-	1	0	-
Apr 90	22	5	4	0	0	0
May 90	89	19	6	0	0	0
June 90	114	1	0	1	1	0
July 90	675	44	53	2	6	0
Aug 90	451	69	29	1	0	0
Sept 90	111	1	7	41	50	5
Total	1509	139	99	65	75	5
No./trap day	0.643	0.063	0.077	0.028	0.034	0.004

Ratcliffe, 1996). Presumably prairie habitats represent stabilized climax conditions, with mammalian faunas that are more established and reliable as food resources than those in the early successional stages of recovering clearcut stands. Forest cover appears to be an important factor in their distribution in central Virginia.

Our samples of *N. orbicollis* were collected between 1 May and 19 October, with an evident peak in July and August. Ratcliffe (1996) reported seasonal data for 8,838 specimens of *N. orbicollis* captured throughout Nebraska with a peak in July and August. Comparisons of Virginia and Nebraska samples by month revealed similar seasonal patterns (Table 2).

Nicrophorus tomentosus

Only 8% as many specimens of *N. tomentosus* (145) was captured at the Cumberland sites compared to the capture total for *N. orbicollis* (1,747). This disparity perhaps indicates the actual relative numerical abundance of these two species, as it seems to be reflected in statewide capture totals (R. L. Hoffman, unpublished data). An apparent difference in habitat preference between the two species with a slightly greater numerical use of old fields by *N. tomentosus* is evident in Table 1. The difference in numbers captured in hardwoods vs old fields is insignificant, however ($X^2 = 0.714$, $P > 0.25$). Pine forests are almost completely avoided by this species ($X^2 = 50.4$, $P < 0.001$; April–September samples only).

Previous studies (e.g., Anderson, 1982; Lingafelter, 1995; Lomolino et al., 1995; Ratcliffe, 1996) have labeled *N. tomentosus* a habitat generalist. The above results suggest that it is less of a generalist in central Virginia than in other areas and almost completely avoids planted pine forests. Against the nearly equal distribution of both species in the two hardwoods sites, *N. tomentosus* showed an inexplicable and significant partiality ($X^2 = 12.50$, $P < 0.001$) for the southern old field (51 specimens) over the northern site (21). Ground-level vegetation was similar between these sites but OF-N had a greater density of vines and OF-S had more seedlings and young loblolly pine (Pagels et al., 1992).

Of the 138 captures of *N. tomentosus*, eight were taken in July. No others were trapped until the last two weeks of August, when a single beetle was captured. Thereafter, captures in September accounted for 24 in 1989 and 96 in 1990, six in October, and one in November. Peak activity for *N. tomentosus* was in September, at least a month later than peak activity for *N. orbicollis*. Curiously, the delayed adult activity by *N. tomentosus* is not evident in Nebraska, where only modest numbers were trapped during September (Table 2). The peak seasonal abundance patterns for *N. orbicollis* and *N. tomentosus* in Virginia appear to be unimodal with obvious seasonal shifts in summer versus fall, respectively. This difference may reflect the occurrence of two reproductive periods, the earlier perhaps consisting of adults which overwintered as pre-pupal larvae.

Although the respective units of each study site pair appeared much the same during their selection, many of the insects trapped, including the burying beetles, exhibited notable partiality for one habitat type or the other (R. L. Hoffman and J. C. Mitchell, unpublished data). Canopy cover varied from 86% in HW-N to 75% in

Table 2. Seasonal pattern of activity of *Nicrophorus orbicollis* and *N. tomentosus* in central Virginia (VA) compared to the patterns in Nebraska (NE) (Ratcliffe, 1996).

	N. orbicollis		*N. tomentosus*	
Month	VA	NE	VA	NE
April	31	0	0	0
May	114	58	0	0
June	115	432	2	186
July	772	2349	8	3157
August	549	5188	1	2413
September	157	597	120	182
October	9	214	6	98
November	0	0	1	0
Total	1747	8838	138	6036

HW-S and both were adjacent to small, perennial streams (Pagels et al., 1992). OF-S was adjacent to a small seep that had intermittent surface water during the study; no sources of water were near OF-N. Subtle differences in microhabitat also affect small mammal community structure; generalists are more often captured in hardwoods, whereas those with edge/old field affinities occurred preferentially in old field communities (Pagels et al., 1992).

The greater abundance of *Nicrophorus tomentosus* at higher elevations in Virginia, and its maximal surface activity in early autumn, suggests a somewhat more cool-adapted organism than the lowland-numerous, midsummer active *N. orbicollis*. The practical effect of these two largely sequential seasonal activity peaks might be reduction of competition for limited resources (dead mammals), already substantially achieved by the ability of *N. tomentosus* to forage in a habitat (old fields) largely avoided by *N. orbicollis*. This likelihood has been noted elsewhere and discussed by Trumbo (1990) and Scott (1998).

Results for *N. orbicollis* in our study confirm our prediction that it occurs more often in hardwoods than other habitat types. *Nicrophorus tomentosus* is not as much of a habitat generalist as expected but appears to have an aversion to planted pine forests, at least in central Virginia. Although these two species of *Nicrophorus* appear to have habitat preferences, their occurrence in all of the habitat types is beneficial because it allows them to sense food sources wherever they are found. Indeed, studies conducted in other places and times with different distributions of decomposing mammals among habitats should generate different results than we found for central Virginia. Their non-overlapping peaks of seasonal activity, however, correspond to patterns described in the literature (e.g., Trumbo, 1990; Scott, 1998) and may be more ingrained than their use of habitats.

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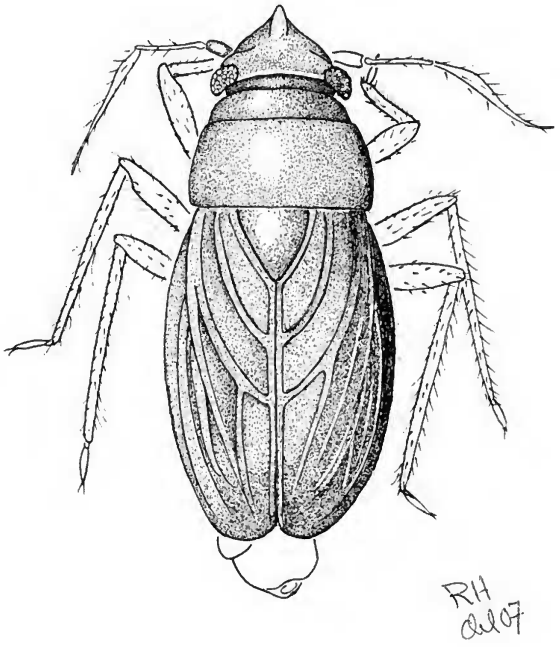

Nannocoris arenarius Blatchley, a rarely collected true bug (Heteroptera: Schizopteridae), length <1.5 mm; original drawing by Richard L. Hoffman (previously published as the back cover illustration for *Banisteria* 30).